DOCUMENT RESUME

ED 277 205 EC 191 712

AUTHOR Stanley, Julian C.
TITLE The Urgent Need for an Academic Focus.
PUB DATE Apr 86
NOTE 16p.; Paper presented at the Annual Conference of the American Educational Research Association (67th, San Francisco, CA, April 16-20, 1986).
PUB TYPE Viewpoints (120) -- Speeches/Conference Papers (150)

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS *Academically Gifted; *Acceleration (Education); Advanced Students; Elementary Secondary Education; Enrichment; Flexible Progression; Mathematics
IDENTIFIERS Study of Mathematically Precocious Youth

ABSTRACT

The founder and director of the Study of Mathematically Precocious Youth (SMPY) at Johns Hopkins University discusses reasons why acceleration is a desirable educational strategy with highly gifted youth. Cases of successful radical acceleration by mathematically gifted youth illustrate the advantages to be gained by many others if the practice of acceleration were to increase. Enrichment is not as effective an educational approach for mathematically gifted students. The real difficulties of individualizing instruction enough to meet the needs of all children in a class make acceleration a more workable approach. Creativity and problem-solving skills cannot be taught effectively when divorced from subject matter content. SMPY's program is a direct approach to preventing the frustration and boredom of many gifted students while maximizing their abilities. Acceleration as implemented by more flexible curricula, subject matter, and grade placement is encouraged by SMPY. (DB)

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The Urgent Need for an Academic Focus*

by Julian C. Stanley

From its inception in 1971 the Study of Mathematically Precocious Youth (SMPY) at Johns Hopkins University has concentrated on the learning of school subjects fast and well. It has paid little explicit attention to dominant themes of the gifted-child movement: enrichment, creativity, problem-solving, futuristics, Olympics of the Mind, training of intellectual aptitudes, work with the disadvantaged gifted, and the like. Some critics of SMPY, eager to erect straw men, have assumed that these facets were overlooked in the original conception of this long-term study. A little information will reveal the inaccuracy of that supposition. I was in the audience at Pennsylvania State University in 1950 when J. P. Guilford gave his now famous presidential address on "Creativity" to persons attending the annual meeting of the American Psychological Association.[1] I was well acquainted with his Structure of Intellect from its early days. Paul Torrance and I were students in different junior colleges in Georgia during the 1930s. Although we never met then, I have followed his work on creativity and futuristics for many years. I have been "in" on the compensatory education movement since 1964.[2]

JULIAN C. STANLEY is a professor in the Department of Psychology at Johns Hopkins University and Director of the Study of Mathematically Precocious Youth (SMPY) there.

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Being an avid reader, having a strong sense of history, and dating back in graduate school to 1938, I have stayed fairly closely in touch with most aspects of intellectual giftedness from the work of Galton, J. McKeen Cattell, Binet, Spearman, Terman, Hollingworth, Truman Kelley, E. L. Thorndike, and Witty to that of current researchers and developers.[3]

SMPY's Main Mission

We of SMPY deliberately chose to help relieve directly the boredom, frustration, and stultification that for intellectually talented boys and girls often result from many years of forced servitude in the age-in-grade Carnegie Unit lock step of most public and private schools. One of our chief motivations for this was that bête noire of mathematically apt youths, the first year of high school algebra. Anyone such as I who has taught that subject knows how elementary and snail-paced for an occasional student Algebra I is, how difficult it is for the average student in the class, and how virtually unlearnable it is for the least apt members. Many of the best mathematical reasoners know a great deal of the subject before entering the course, because they were learning it incidentally while taking general mathematics. It is not uncommon for a mathematically bright 12-year-old to score at or above the 90th percentile of the rather strict norms of the Algebra I test of the Cooperative Achievement Tests a year or two before he or she is permitted even to begin the subject. One we knew earned a perfect score, 40 correct out of 40 multiple-choice items in 40 minutes, at age 12 as a seventh grader. The 99.6th percentile of the ninth-grade norms is a score of 37.

Unfortunately, virtually no schools systematically make this kind of assessment, so even a youth who scores higher on the standardized test than the algebra teacher in his or her school might must, nevertheless, sit for 180 45- or 50-minute periods in the beginning algebra course. Isn't it remarkable that any able young person remains at all interested in mathematics? We of SMPY are convinced, from observation and systematic study, that many do become implicit drop-outs from mathematics and related subjects because of the interminable boredom they are forced to endure.

Examples of Moving Ahead Appropriately

There was a happy ending for the boy with the perfect score. At SMPY's suggestion, he had taken the test to try to convince the algebra teacher that he was ready to enter the class in the middle of the year, although being only a seventh grader who missed the first half. When the teacher saw the 40, he said, "You really are ready to take the last half of Algebra I." The boy was too wise for that, however, and instead enrolled part-time in the honors mathematics program of the University of Maryland. By the senior year of high school he was a member of the United States team in the 1979 International Mathematical Olympiad. Without the influence of the test, almost surely he would not have been well enough prepared and motivated for that stellar accomplishment.

Essentially the same thing happened to two other boys a few years later. One served on the IMO team at ages 15 and 16. The other, "discovered" by SMPY at age 11, has been on the team four consecutive years (1983-86), beginning at age 13,

perhaps the world's record for this event. Early avoidance of too-elementary mathematics, combined with special summer work, enabled him to take Advanced Placement Program calculus in high school at age 12 and mathematics courses at Columbia University thereafter while remaining in high school for other subjects.

The boy who was on the team twice earned his master's degree in mathematics by age 17 and then went to a famous university to start work on his doctorate. He took no high school mathematics from Algebra I onward, but graduated from high school only a year early after being a part-time college student several years.

A mathematically brilliant boy from Guatemala completed high school and college in Baltimore at age 17, majoring in mathematics. Another was graduated from Johns Hopkins with top honors in physics at age 15 and, while still that age, went to Cambridge University on a one-year Churchill Scholarship. Then he entered a great university as a graduate student in biophysics.

A young woman, first-generation American of Japanese parentage, took her B.A. degree in mathematics at Johns Hopkins before age 19 and won a Rhodes Scholarship, probably the youngest U.S. female to do so since women were permitted to compete for that prestigious award. By November of the same year she completed all requirements for the M.A. degree in mathematics. She is likely to finish her D.Phil. degree in mathematics from Oxford University about the time she becomes 23 years old.

In June of 1985 a 17-year-old woman received her bachelor's degree in mathematics from the University of Wisconsin with high honors (e.g., election to membership in Phi Beta Kappa at age 16), and in the fall became a graduate student in mathematics at one of

the country's top universities.

More Can Benefit

These stories of great achievement and "radical acceleration" could go on and on. They are not typical and representative of our overall experiences, of course, but just the top of the educational iceberg. This is an a fortiori argument, that if a few brilliant students can readily be helped to move this fast excellently, then all the more so should at least a little acceleration in the subject matter of one's greatest aptitude be encouraged for quite a few others. If some can do without any high school mathematics, then shouldn't well-qualified students at least be permitted to begin algebra a year or two early?

But, many ask, why not instead "enrich" the mathematics taken by youths who reason exceptionally well mathematically? The expression "educational enrichment" sounds far better than it usually deserves. In particular, we of SMPY believe that youths with highly developed special mental abilities such as mathematical reasoning need to progress fast through the elementary aspects of the subject they already know or can learn extremely quickly so that they can then get greater rigor and challenge at a more advanced level.

For example, the higher level (BC) of the Advanced Placement Program's college-level calculus is so readily learned by extremely math-talented youths that some of SMPY's protégés earn the top possible grade, 5, on the examination as young as age 9, 10, 11, or 12. That is equivalent to making a grade of A+ in two semesters of calculus at a highly selective college or university

such as Johns Hopkins, most of which institutions award full credit for 4s or sometimes even 3s. In May of 1985 only 2919 5s were earned in the entire country, out of a birth group of some four million persons. That's 1 in about 1400. Most of these top scores were received by twelfth graders, but many of those seniors and others would have profited by taking the AP course and examination earlier than that. Most of them did not know that such was possible nor have any encouragement to do so.

Another example is the learning of the first year of high-school biology, chemistry, or physics well in three intensive weeks.*

Being Prepared

Take the case of a Korean-American I know rather well. At age 15 this Michigander placed in the top 40 winners in the national 1986 Science Talent Search sponsored by the Westinghouse Corporation. His project, done chiefly in four weeks while he was a student in the Rickover Science Institute during the summer of 1985, involved sophisticated use of calculus and trigonometry. How could a 15-year-old have developed such competency, when calculus is usually a twelfth-grade subject for the few U.S. students who take it? He had learned precalculus quickly in special summer programs, taken calculus in high school early, and then scored 5 on the higher level (BC) of the AP calculus examination at age 13. Before the Rickover program began, he had earned 5s on both parts of the difficult Level C AP physics examination, Mechanics and Electricity & Magnetism. Here was a young man, also a varsity football player at age 15 and karate

expert, hockey player, and runner, well equipped "before his time" to take full advantage of special opportunities when they arise. Still age 16 until December of 1986, he entered Harvard College that fall as a National Scholar. His is the stuff of which paradigm-shifting scientists tend to be made.[5]

Difficult to Individualize Within Class

Ideally, each teacher of any subject would individualize his or her instruction so well that no special provisions would be needed. In practice, that usually proves impossible. The already overburdened teacher has neither the time nor the background with which to do this. That is why special provisions for the gifted are urged by many. As noted earlier, they are usually offered some form of "enrichment," rather than dealing directly with the individual student's intellectual hunger. A number of years ago I pondered about this and devised a four-category classification of enrichment. It was my intent to point out how the student's real needs are usually bypassed by procedures termed enrichment, compared with appropriate curricular flexibility and proper articulation of prior learning and special experiences with the next step in the instructional hierarchy.[6]

Strengthening Mental Abilities

Sometimes I have railed against what I derisively termed "creativity in a subject-matter vacuum." Training in creativity and in problem solving may be interesting in their own right and important, if done properly, but usually they are divorced from formal school subjects. This leaves the intellectually talented

student, especially the one with a high special ability such as mathematical or verbal reasoning, at least as bored and frustrated in his class as ever. In that event, creativity and problem solving training are a form of what I call "irrelevant" enrichment--that is, they are largely irrelevant to the specific academic needs of the child. At their worst, they become a form of mental-muscle training, trying to improve directly a presumed trait called creativity or aptitudes such as general intelligence, critical thinking ability, or mathematical reasoning ability. This contrasts with using such aptitudes to further the high-level, creative learning of school subjects per se. I am surprised that more specialists in the education of intellectually talented youths have not harked back to the controversy around the turn of the century about "faculty psychology" (i.e., the mind as composed of a number of trainable faculties) and "mental discipline." Both of these constructs fared poorly when scrutinized by outstanding psychologists of the era. Largely, they went out with phrenology and E. L. Thorndike's Law of Exercise.

They seem to have been ushered back via Guilford's Structure of Intellect during the 1950s. SOI itself does not fare well at the hands of psychologists, either.[7] Nevertheless, it greatly reinforced the efforts of educational practitioners to continue "enriching" the education of gifted children rather than working directly with school subject matter.

The Direct Approach

A psychologist at Duke University, Professor Michael Wallach,

put the case far better than I could.[8] In reviewing SMPY's third book he wrote, in part, as follows:

"What is particularly striking [in this book] is how little that is distinctly psychological seems involved in SMPY, and yet how very fruitful SMPY appears to be. It is as if trying to be psychological throws us off the course and into a mire of abstract dispositions that help little in facilitating students' demonstrable talents. What seems most successful for helping students is what stays closest to the competencies one directly cares about: in the case of SMPY, for example, finding students who are very good at math and arranging the environment to help them learn it as well as possible. One would expect analogous prescriptions to be of benefit for fostering talent in writing, music, art, and any other competencies that can be specified in product or performance terms. But all this in fact is not unpsychological; it is simply different psychology."

Of course, often young people talented in music, dance, art, and athletics are encouraged to progress at each one's individual pace. Why should what we term academic subjects not be accorded the same approach?

Conclusion

We of SMPY want intellectually talented school children to have the best possible instruction in the classroom. Also, we urge far more curricular flexibility of many sorts. An important component of this is <u>permitting</u> educational acceleration, both in subject matter and school grade placement. For each talented youth each year an individualized plan should be worked out, to

take into account various abilities, family characteristics, local educational facilities, and especially the student's preferences. For the gifted this type of planning requires ingenuity, more than time or money. Over the years SMPY has saved many schools a great deal of frustration and extra expenditures. Its suggestions are cost-effective. Helping able youths move at their natural pace from kindergarten through professional school is far less costly and vastly more educationally productive than setting up holding operations to keep them age-in-grade-in-subject.

Let me close with four lines of one of my favorite poems, Thomas Gray's "Elegy Written in a Country Churchyard." I've used them several times before in my talks and articles, but they are too enduringly apt not to be repeated here:

Full many a gem of purest ray serene
The dark unfathomed caves of ocean bear;
Full many a flower is born to blush unseen,
And waste its sweetness on the desert air.

Gray also mentioned the "mute, inglorious Miltons" buried in that obscure churchyard. It is our dedicated task to prevent waste of human talents. Early identification of persons variously talented, augmented by appropriate academic emphases, curricular flexibility, and proper articulation, can take us far toward that goal.[9]

Footnotes

*Paper read at the annual meeting of the American Educational Research Association in San Francisco on 19 April 1986. I thank Camilla Benbow, Linda Brody, Lois S. Sandhofer, and Barbara S. K. Stanley for assistance in preparing it.

[1]Joy P. Guilford, "Creativity," American Psychologist, 1950, 5(9, Sept.), 444-454.

[2]E.g., Julian C. Stanley, "Predicting College Success of the Educationally Disadvantaged," Science, 1971, 171(3972, Feb. 19), 640-647; Julian C. Stanley (Ed.), Preschool Programs for the Disadvantaged: Five Experimental Approaches to Early Childhood Education, and Compensatory Education for Children, Ages 2 to 8: Recent Studies of Educational Intervention (Baltimore: Johns Hopkins University Press, 1972 and 1973, respectively).

[3]For the rationale of SMPY, see Julian C. Stanley, "Rationale of the Study of Mathematically Precocious Youth (SMPY) During Its First Five Years of Promoting Educational Acceleration," pages 75-112 in Julian C. Stanley, William C. George, and Cecilia H. Solano (Eds.), The Gifted and the Creative: A Fifty-Year Perspective (Baltimore: Johns Hopkins University Press, 1977); Julian C. Stanley, "The Study and Facilitation of Talent for Mathematics," pages 169-185 in A. Harry Passow (Ed.), The Gifted and the Talented: Their Education and Development, Seventy-eighth Yearbook of the National Society for the Study of Education (Chicago: University of Chicago Press, 1979); and Julian C. Stanley and Camilla P. Benbow, "Youths Who Reason Extremely Well Mathematically," in Robert J. Sternberg and Janet E. Davidson (Eds.), Conceptions of Giftedness (Cambridge, England:

Cambridge University Press, 1986).

[4]Julian C. Stanley and Barbara S. K. Stanley, "High-School Biology, Chemistry, or Physics Learned Well in Three Weeks," Journal of Research in Science Teaching, 1986, 23(3, March), 237-250.

[5]Thomas S. Kuhn, The Structure of Scientific Revolutions (2nd ed.), International Encyclopedia of Unified Science, vol. 2, no. 2 (Chicago: University of Chicago Press, 1970). For the important concept of "cumulative educational advantage" and how it figured in the lives of American Nobel Laureates, see Harriet Zuckerman, Scientific Elite: Nobel Laureates in the United States (New York: Free Press, 1977).

[6]Julian C. Stanley, Identifying and Nurturing the Intellectually Gifted," Phi Delta Kappan, 1976, 58(3, Nov.), 234-238.

[7]E.g., see Margaret L. Harris and Chester W. Harris, "A Factor Analytic Interpretation Strategy," Educational and Psychological Measurement, 1971, 31(3), 589-606; John L. Horn and John R. Knapp, "On the Subjective Character of the Empirical Base of Guilford's Structure-of-Intellect Model," Psychological Bulletin, 1973, 80(1, Jan.), 33-43; Joy P. Guilford, "Rotational Problems in Factor Analysis," Psychological Bulletin, 1974, 81(8, Aug.), 498-501; John L. Horn and John R. Knapp, "Thirty Wrongs Do Not Make a Right," Psychological Bulletin, 1974, 81(8, Aug.), 502-504; John L. Horn, "Human Abilities: A Review of Research and Theory in the Early 1970s," Annual Review of Psychology, 27, 437-485; Michael A. Wallach, "Care and Feeding of the Gifted," review of Julian C. Stanley, William C. George, and Cecilia H.

Solano (Eds.), The Gifted and the Creative: A Fifty-Year Perspective (Baltimore: Johns Hopkins University Press, 1977), Contemporary Psychology, 1978, 23(9, Sept.), 616-617; Harvey F. Clarizio and William A. Mehrens, "Psychometric Limitations of Guilford's Structure-of-Intellect Model for Identification and Programming of the Gifted," Gifted Child Quarterly, 1985, 29(3, Summer), 113-120; and Gale Roid, "Limitations of the Test Reviewing Process: A Response to Clarizio and Mehrens," Gifted Child Quarterly, 1985, 29(3, Summer), 121-123.

[8]Wallach, ibid.

[9]SMPY's scope is becoming international. The mathematically ablest youth it has found lives in Australia (Julian C. Stanley, "Terry Tao: Astoundingly Excellent Nonverbal Reasoner," G/C/T, in press). SMPY initiated the first use of the mathematical part of the College Board's Scholastic Aptitude Test in the People's Republic of China (Julian C. Stanley, Jia-fen Huang, and Xue-min Zu, "SAT-M Scores of Highly Selected Students in Shanghai Tested When Less Than 13 Years Old," College Board Review, Summer 1986, Issue No. 140). Also, SMPY studies the records of persons who become full-time college students quite young or graduate from college before age 19. See Julian C. Stanley and Camilla P. Benbow, "Extremely Young College Graduates: Evidence of Their Success," College and University, 1983, 58(4, Summer), 361-371; Julian C. Stanley, "Young Entrants to College: How Did They Fare?", College and University, 1985, 60(3, Spring), 219-228, and/"How Did Six Highly Accelerated Gifted Students Fare in Graduate School?", Gifted Child Quarterly, 1985, 29(4, Fall), 180; and Julian C. Stanley and Ann M. McGill, "More About 'Early

Entrants to College: How Did They Fare?'", Gifted Child Quarterly, 1986, 30(2, Spring), 70-73.

Paper presented at the Annual Conference of the American Educational Research Association (67th, San Francisco, CA, April 16-20, 1986).